

T01D02 – Molarity & Limiting Reactants

Name

*FYI – the Molarity equation is: Molarity (M) = moles (mol) of solute / liters (L) of solution



1. Calculate the **molarity** of each of the following: **[Review formula before beginning #1-3]**

a. 24.5 grams of sodium hydroxide are added to water to make 250 mL of solution

b. 15.5 grams of copper (II) sulfate are added to water to make 200 mL of solution

2. Calculate the number of grams of solute in each of the following:

a. 125 mL of a 0.15 M solution of silver nitrate

b. 333 mL of a 0.33 M solution of aluminum nitrate

3. Calculate the volume of each solution in mL:

a. 0.50 M solution contains 0.12 moles of sodium chloride

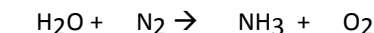
b. 6.00 M solution of sodium hydroxide contains 15.5 moles of sodium hydroxide

Limiting Reactants and Percent Yield

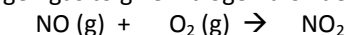
4. Calculate the theoretical yield of $\text{C}_2\text{H}_5\text{Cl}$ if 112 g of $\text{C}_2\text{H}_5\text{OH}$ is reacted with 34.7 g of PCl_3 based on the reaction below. If 23.7 g of $\text{C}_2\text{H}_5\text{Cl}$ is produced, what is the percent yield?



5. 2.09 grams of water are mixed with 11.0 g of nitrogen. What is the limiting reactant? How much NH_3 can be produced? What is the excess reactant, and how much is left over?



6. Nitric oxide (NO) reacts instantly with oxygen gas to give nitrogen dioxide, a dark brown gas.

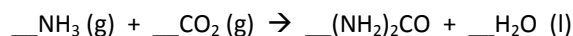


If 0.866 mole of NO is mixed with 17.55 grams of oxygen gas what is the maximum yield of nitrogen dioxide that can be produced? Name the reactant that is considered limiting, and the excess reactant.

7. If 0.86 mole of manganese (IV) oxide reacts with 48.2 grams of hydrochloric acid how many grams of chlorine gas can be produced (aka maximum yield)?



8. Urea $[(\text{NH}_2)_2\text{CO}]$ is used as a fertilizer, as an animal feed, and in the polymer industry. It is prepared in a reaction between ammonia and carbon dioxide:



In one process, 637.2 grams of ammonia are allowed to react with 1142 grams of carbon dioxide.

Which of the two reactants is the limiting reactant? Calculate the maximum yield of urea? How much excess reactant in grams is left at the end? Suppose only 1000. grams of urea are produced in this reaction, what is the percent yield?

Mass-Mass, Mass-Volume and Limiting Reactant Problems (All of these equations are skeletons (ie. not balanced))

- 10) $\text{FeS} + \text{HCl} \rightarrow \text{H}_2\text{S} + \text{FeCl}_2$
 $\text{CaCO}_3 + \text{HCl} \rightarrow \text{CO}_2 + \text{CaCl}_2 + \text{H}_2\text{O}$
 $\text{NH}_4\text{Cl} + \text{CaO} \rightarrow \text{NH}_3 + \text{CaCl}_2 + \text{H}_2\text{O}$
 $\text{NaCl} + \text{H}_2\text{SO}_4 \rightarrow \text{HCl} + \text{NaHSO}_4$
 $\text{NH}_4\text{Cl} + \text{NaNO}_3 \rightarrow \text{N}_2\text{O} + \text{NaCl} + \text{H}_2\text{O}$
 $\text{Al} + \text{H}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + \text{H}_2$
 $\text{CaC}_2 + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_2 + \text{Ca}(\text{OH})_2$

Using one of the above equations solve each of the following problems: [All conditions where gases are produced are at STP]

- How many grams of limestone, calcium carbonate, are needed to prepare 10,000 pounds of dry ice, carbon dioxide?
- How many grams of ammonium chloride are needed to produce 1.7 grams of ammonia?
- A whipped cream manufacturer wishes to prepare 500 pounds of nitrogen (I) oxide. How much (grams) of ammonium chloride and other product are necessary to produce that amount of nitrogen (I) oxide?
- How many grams of aluminum are needed to produce enough hydrogen to fill a balloon that is 2 meters in diameter? [Assume the balloon is spherical, and remember Avogadro's Law] There is sufficient sulfuric acid so that the aluminum is the limiting reactant?
- How much hydrogen sulfide, H_2S , gas can be produced from 115.5 grams of iron (II) sulfide, and 250. mL of 3.0 M hydrochloric acid?